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Eco-innovation: reflections on an evolving research agenda

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Abstract: This short paper reviews some trends in social science research on eco-innovation, drawing attention to four trends in particular: better disaggregated empirical research on firms, research on knowledge and technology flows, linkage of economic and physical models and growing sophistication in the analysis of policy and governance on eco-innovation. While these are important advances, there remains plenty to do.

Keywords: eco-innovation; research agenda.

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Biographical notes: Frans Berkhout is a Professor of Innovation and Sustainability and Director of the Institute for Environmental Studies (IVM) and of the Amsterdam Global Change Institute at the VU University in Amsterdam, The Netherlands. He has extensive research, research management and research training experience across a number of fields. His early research was concerned with the economic, political and security aspects of the nuclear fuel cycle and radioactive waste management. His current work has been concerned with technology, policy and sustainability, with a specific focus on climate policy.

1 Introduction

About 20 years ago, Michael Porter's (1991) important hypothesis that more stringent environmental regulations could spur innovation, thereby offsetting the additional costs to business and consumers of regulation became a key argument in the debate about sustainable development (given political force at the Rio Earth Summit in 1992). Technological, organisational and behavioural change came to be seen as the principal means by which the conflicting objectives of economic growth, environmental protection and social development could be reconciled. One outcome of these developments was the growth of a broad new research agenda about technological innovation and environmental policy which has also had a marked impact on environmental, innovation and trade policies in Europe, the USA and increasingly also in Asia. Broadly, there were three central research questions: How do public policies influence incentives of firms to innovate more resource efficient and environmentally friendly goods and services? Is

there evidence that environmental regulation leads to more innovation across industries? And, what new public policies would give firms greater incentives to innovate 'greener' goods and services?

Without attempting to summarise the huge literature that has developed since 1990, a literature which itself drew on a longer tradition within economics on the role and costs of regulation (for instance, Stigler, 1971), we can see an evolution in the research carried out on eco-innovation. Broadly, we can identify four trends:

1 increasingly disaggregated analysis of eco-innovation, especially as a result of greater empirical evidence from broad populations of firms

2 better understanding of knowledge and technological flows related to eco-innovation

3 a greater capacity to link economic models with models of physical flows of resources and pollutants

4 greater sophistication in analysing the roles of policy in influencing innovation by firms.

On the other hand, there are also still a number of important gaps in what our analysis can tell us: it remains difficult to plot with any confidence the full chain of cause-and-effect between greater investments in science, technology and innovation (STI), and long-run changes in the eco-efficiency of goods and services consumed in the economy; the link to 'green' employment (such an important element in the current political debate) also remains under-developed; and our analysis has still not come to grips with the central claim of 'governance', that not only public policy, but also other political, cultural and market factors influence innovation, including eco-innovation.

2 Disaggregated analysis

The growing availability of panel data about firms and households, gathered through instruments like the European Community Innovation Survey, which have added specific questions about eco-innovations and the motivations of innovators and consumers, has allowed researchers to move beyond the case study research of firms, which typified much early work. These broad measurements are possible because much effort has been invested in getting definitions formalised and widely accepted. The question, 'What is an eco-innovation?' no longer generates heated academic debate. It has for practical purposes been settled. Theory and propositions arising from theory can now be tested in a systematic way against evidence from large multi-national samples of firms collected in harmonised ways and over-time. This has greatly strengthened the validity of knowledge claims coming from research, even if there is still a long way to go. Examples of research discussed at the Mannheim workshop, include that of Horbach on eco-innovation across different sectors and that of Scazny for households. Horbach and others are beginning to show that the determinants of eco-innovation vary across different technological fields. For instance, regulations appear to have a greater impact on process innovation, but not across all product fields. Similarly, environmental management systems are important for processes but not for products. We can develop explanations for these patterns (for instance, related to the appropriability of innovation rents from process innovation

compared to products) which will generate new research through surveys and case studies.

3 Knowledge and technology flows

Mainstream innovation studies have long been concerned with how flows of knowledge and the capacity of firms to innovate are related to each other. Some sectors are science intensive, whereas others rely more on good knowledge of markets, or on engineering knowledge. Leading and innovating firms have different routines related to developing and searching for knowledge than follower firms, especially those in less-developed countries. Eco-innovation research has also become increasingly concerned with these important aspects of the puzzle of business (and market) innovation. Examples include a growing attention for intellectual property rights (IPR) in relation to eco-innovations. A central argument here is the well-known problem that if the innovator is not given the right to appropriate innovation rents (under certain conditions) he/she will be reluctant to make risky investments in research, development and innovation because other firms will learn and imitate, so benefitting without having made the upfront investment. But protection of the innovator runs counter to the benefits of a rapid diffusion of good ideas in the economy, especially where public goods, like environmental protection, may be secured. The question for the policy-maker is: what is the right balance between protection for the innovator (a constraint on knowledge flows) and availability of new ideas for broad use (the enabling of knowledge flows). Drawing on the debate about the role of IPR and its effects on the availability of drugs for AIDS in poor countries, international climate change policy has recently become embroiled in a debate about technology transfer to non-OECD countries and the role of IPR in limiting such knowledge and technology flows. New research presented at the Mannheim workshop by Waltz and Glachant shows that there are many channels by which knowledge and technology flows (including licences, trade and foreign direct investment), some of which are subject to public policy (such as domestic content requirements). This research shows that it is likely that the development of technological capabilities and trade barriers will be the main influences on innovation and diffusion of eco-innovations, rather than IPR measures like patent protection.

4 Linking economic models with physical models

One of the key notions of the first decade of eco-innovation research was *decoupling*: the undoing of the apparently fixed relationship between economic growth and use of resources and ecosystem services. New technologies would play a key role in achieving decoupling, whether relative or absolute. To research this relationship it became important to be able to understand how economic phenomena, like growth and innovation, related to physical phenomena, like the emission of greenhouse gases. We have seen the emergence of increasingly sophisticated integrated models which link economic and physical components. Good examples are the integrated assessment models that have become such an important instrument in political debates about climate and biodiversity policies. One of the limitations with these models is their rather mechanical treatment of innovation – focusing on the marginal costs of currently

available technologies and assumptions about technological learning in future leading to cost reductions. Another is that analysis is at a highly aggregated global level. Clearly, there is a need to improve both the treatment of innovation in these models, including insights from evolutionary economics with its concern with technological variety and selection, and to link these with the analysis of physical stocks and flows of materials and energy. Much progress has been made in the field of industrial ecology, using approaches such as materials flow and life cycle analysis to understand the environmental footprint of firms, products and whole industrial systems. Gradually, this physical analysis is being linked to analysis of innovation, as in the new Eco-Innovation Observatory reported by Bleischewitz in Mannheim. Such analysis is an important condition for understanding the environmental impact of eco-innovation policies, helping us to answer the question: when does a new product or process generate environmental saving, rather than the opposite.

5 Understanding the roles of policy

Research has an intrinsic value, but it becomes something really valuable when it can be useful. Two of the key questions of the research agenda identified above concerned the impact of policy on eco-innovation and the (re)design of policy to foster eco-innovation. These are extremely complex questions to answer, primarily because many factors are at play which are often themselves inter-related. For instance, either anticipated higher prices for energy or an anticipated rising price for carbon credits may influence the propensity of energy firms to invest in renewable technology R&D, with both of these changes linked to perceptions about the political salience of climate change as a serious environmental issue. Increasingly eco-innovation research has sought to use multiple methods, including analysis of survey data, econometric modelling, together with in-depth case studies, to disentangle the relative influence of different factors. The work of Rogge et al. looking at the innovation impacts in the German power sector of the EU emissions trading scheme (conclusion: it stimulated investments in carbon capture and storage) is an excellent example of this increasingly nuanced approach. But this work also shows that the innovation impacts of policy often take time. There can be considerable lags before the policy signal has worked itself through to broadly diffused technologies – political strategy over the long run is an important factor. For this broader arguments are also important. Löschel in his macro-economic modelling shows that investments in sustainability-oriented STI produce lower costs earlier for key technologies through knowledge spillovers. But they also produce general impacts on growth and welfare. This is a powerful general argument for public investments in eco-innovation. Embedding eco-innovation in the mainstream of innovation research and STI policy remains an objective for the future, although great strides have already been made.

6 Remaining gaps: tracing the chain from science through to environmental impact, green jobs and governance

If anything, the importance of the eco-innovation research is greater now than ever, not only because of the urgency of environmental problems, but also because of the political interest in sustainable technologies. But there is still a long way to go before we have are able to fulfil our own expectations. There remain many uncertainties and paradoxes about

the relationship between different influences on private and public investments in eco-innovation and the broad use of alternative ways of meeting economic and social needs for food, mobility and comfort. The challenge is to be able to understand these links and relationships so shaping policies that stimulate transitions in major sectors of the economy, such as the energy sector, towards greater sustainability over the long run. A start has been made with transitions research, but this has yet to connect with eco-innovation research, let alone mainstream macro-economic research. Transitions entail deep structural change in economies, with the creation of new technologies, firms and sectors, replacing incumbents in waves of creative destruction. Understanding and stimulating such change over the long term is now the goal of policy in many countries, with innovation the main driver. But we are still not at a point where we can explain, through theory and empirical evidence, how the chain from STI policies extends to new eco-innovations and green jobs, all achieved through new relationships between government, the market and the broader polity as predicted by theories of governance.

References

Porter, M.E. (1991) 'America's green strategy', *Scientific American*, Vol. 264, No. 4, p.168.

Stigler, G.J. (1971) 'The theory of economic regulation', *The Bell Journal of Economics and Management Science*, Vol. 2, No. 1, pp.3–21.

Note

This paper is a review of the workshop 'Regulation and Management of Innovations Towards Sustainable Development' in Mannheim early October 2010. Agenda see Appendix.

Appendix

Workshop on Regulation and Management of Innovations Towards Sustainable Development

Background and motivation

During the past 15 years a lot of work has been done in eco-innovation research. Within the same time, the topic has received increased attention from policy-makers, e.g. specific programmes for promoting eco-innovations have been introduced in the European Commission and Germany. Concepts, such as transition management and the lead market concept, have been theoretically developed and empirically tested. The research community has broadened and split up in different sub-groups, such as engineering, socio-economic and socio-ecological research. Due to these different streams, the eco-innovation research community is split up in different sub-groups that do not know each other very well. The aim of this workshop is to discuss the latest state of research on eco-innovation to the research communities of environmental economists, business management, innovation researchers and socio-ecological researchers, while at the same time exchanging ideas and research needs with policy-makers.

Organisers:

Klaus Rennings, ZEW Mannheim

René Kemp, University of Maastricht

Time: 6 and 7 October 2010

Venue: ZEW Mannheim

First day: **The economics of eco-innovation**

Chair: Klaus Rennings

Expectations from policy-makers: Which insights and results are needed?

Bertrand Wert, EU Commission, DG Enterprise, Innovation Unit, Frans A. van der Loo, General Secretary, Energy Transitions, The Netherlands

Session 1: The economics of eco-innovation

René Kemp, University of Maastricht: *Efficiency revolution or absolute decoupling – What is the scope of an eco-innovation strategy?*

Jens Horbach, Augsburg University of Applied Sciences: *Determinants of eco-innovations in different technology areas – results for Germany based on the community innovation survey*

Massimiliano Mazzanti, University of Ferrara: *Environmental innovation drivers and economic performance in industrial systems*

Session 2: Intellectual property rights and eco-innovation policy

Jerome Reichman, Duke Law School, Durham: *Intellectual property and alternatives – strategies for green innovation*

Xavier Leflaive, OECD: *The role of patents for eco-innovation research*

Rainer Walz, Fraunhofer ISI: *IPR policies in emerging economies – the case of China*

Glachant, Matthieu, MINES ParisTech: *Invention and transfer of climate change mitigation technologies on a global scale: a study drawing on patent data*

Second day: **Policies and management of environmental innovations**

Chair: René Kemp

Session 3: Industrial ecology and economic analysis

Gjalt Huppes, Leiden University**:** *Linking economic and environmental performance of eco-innovations*

Frank Pothen, ZEW: *Industrial ecology in policy-making – What is achievable and what is not?*

Raimund Bleischwitz, Wuppertal Institute, Michal Miedzinski, Technopolis Group, Brussels: *Linking material flow analysis with eco-innovation research – the European eco-innovation observatory*

Session 4: Eco-innovation policy – concepts and practical experiences

Andreas Löschel, ZEW: *Directed technical change and differentiated climate policy*

Karoline Rogge, Fraunhofer ISI: *The innovation impact of the EU emission trading system*

Frans A. van der Loo, Energy Transitions: *Experiences with transition management in the Netherlands*

Xavier Leflaive, OECD: *How to support eco-innovations?*

Session 5: The demand side – adoption of eco-innovative technologies in households

Milan Scazny, Charles University Prague: *Household behaviour and environmental policy: residential energy efficiency*

Rolf Wüstenhagen, University St. Gallen: *Adaptation of energy-efficient TVs – the role of eco-labels*

Martin Achtnicht, ZEW: *Heating or insulation – What do consumers prefer?*

Wrap up: bringing together the different perspectives

Chair: F. Berkhout, VU University, Amsterdam

Bertrand Wert, EU Commission, DG Enterprise, Innovation Unit, Frans A. van der Loo, General Secretary Energy Transitions, The Netherlands, Rainer Walz, ISI Institute, Karlsruhe Klaus Rennings, ZEW, Mannheim